Developing an Effective Approach for Assessment of Terrestrial Carbon Inventories and Dynamics: *Challenges and Promise*

Los Alamos

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NETL

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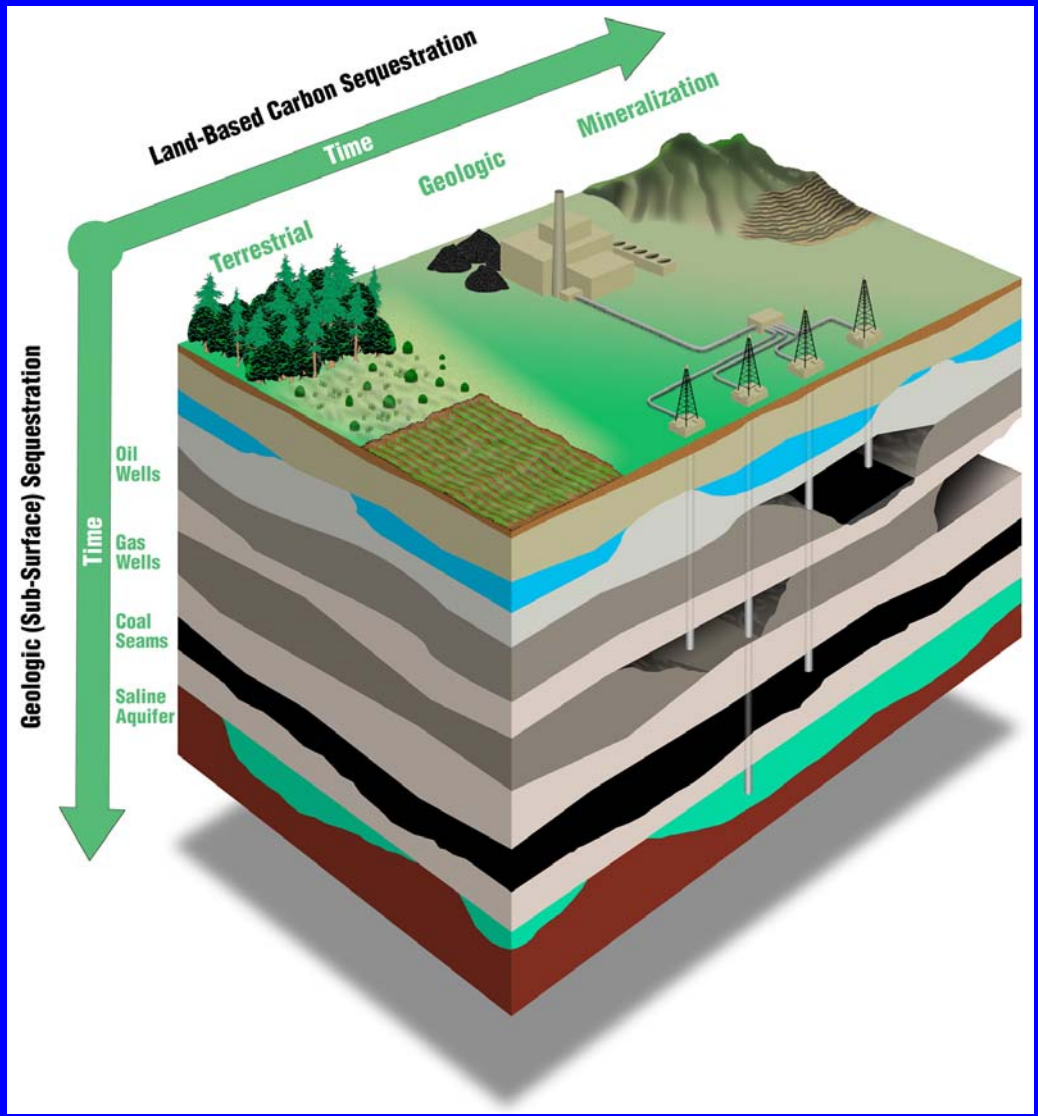
Abstract

Terrestrial carbon fluxes account for more than half of the carbon transferred between land and atmosphere. The amount of carbon that could be sequestered terrestrially is potentially large but controversial. Further, even if we cannot sequester large amounts of carbon, it will be important to consider potential large rapid carbon losses, such as those caused by fire and drought and associated erosion. To manage carbon, we must be able to account for it, via measurement or modeling. Here we provide an overview of these issues and discuss options for developing an integrated approach for addressing this important and complex issue.

Land-Based Carbon Sequestration



An Integrated Approach

- ✓ Terrestrial
- ✓ Geologic
- ✓ Mineralization

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Advantages of Terrestrial Carbon Management and Sequestration

- ✓ ***Readily Deployable – over next few decades***
  DOE Offices of Science and Fossil Energy Roadmaps

- ✓ ***Ecologically Acceptable - positive ancillary benefits***
  Environmental groups and industry involvement

- ✓ ***Economically Viable - best current option for <$10/ton***
  *Economic assessment - McCarl et al. 2001**
  Industry investment – Power companies

* Proceedings of the NETL 1st National Carbon Sequestration Conference

Key Practical Issues

- What is the inventory of terrestrial carbon at a site and how do we measure it ?
- Can we measure, monitor, and manage carbon changes at a site cost-effectively and accurately?
- Can we manage terrestrial ecosystems effectively for carbon sequestration?

Key Technical Issues and Challenges

If carbon is to be a commodity, we must measure it accurately and manage it effectively

- **Verification** – *measuring carbon*
- **Permanence** – *site-specific longevity of carbon*

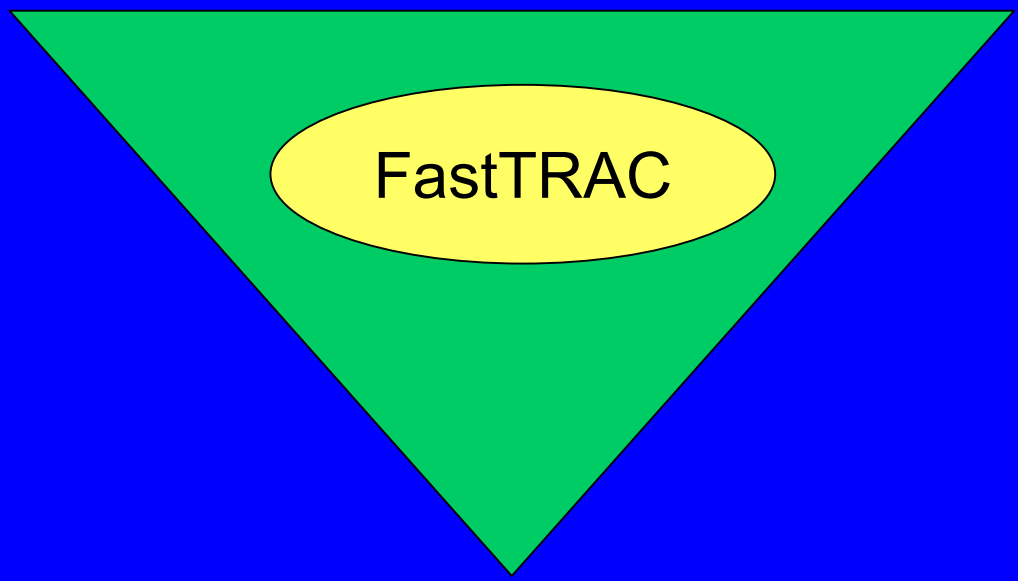
Improved measurement and assessment methods are required

Scholes & Noble 2001 - *Science* 294: 1012

Integrated Advancement Towards FastTRAC

Fast Technology for high-Resolution Assessment of Carbon

1. Measurement & Assessment Technology



2. Field Applications

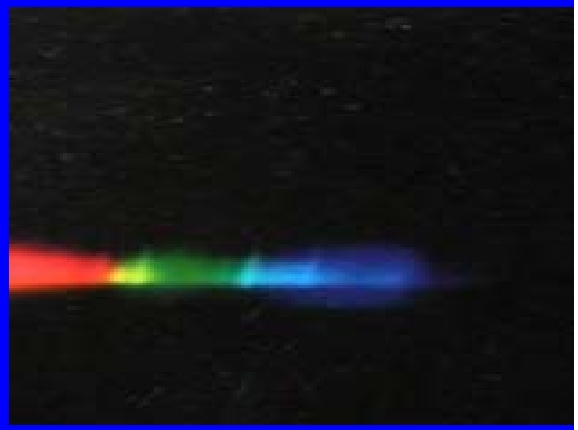
3. Risk & Uncertainty Assessment

Components of an Effective Approach

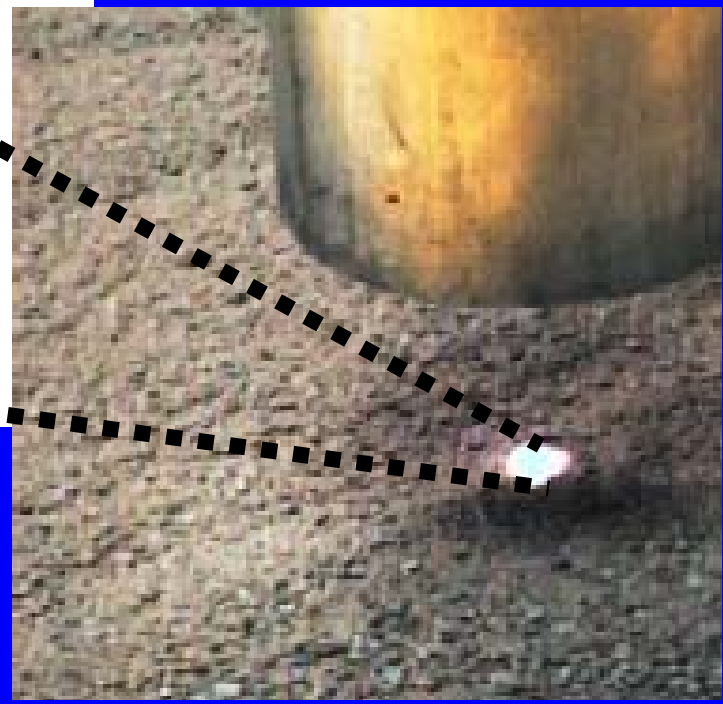
- ✓ Improved inventory methods
- ✓ Realistic projections
- ✓ Effective evaluation of management alternatives
- ✓ Early verification of response to management
- ✓ Economically viable
- ✓ Safe and environmentally acceptable

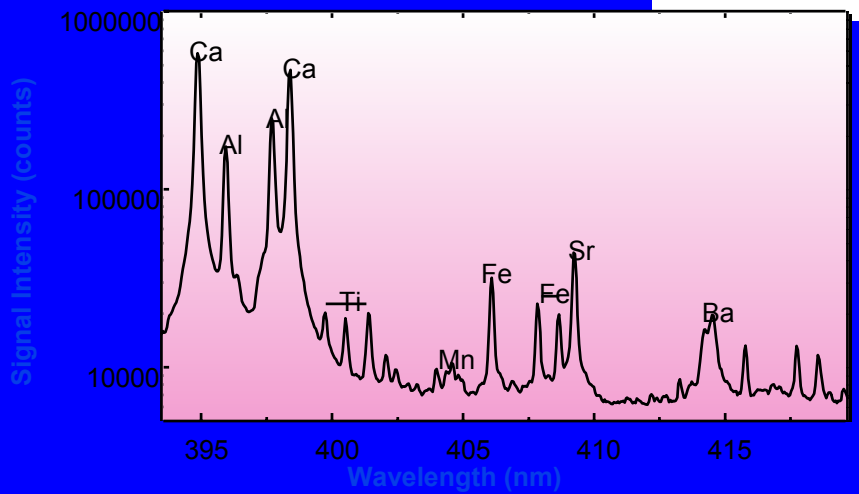
LIBS Spectrum of Soil

Visible Spectrum of Plasma

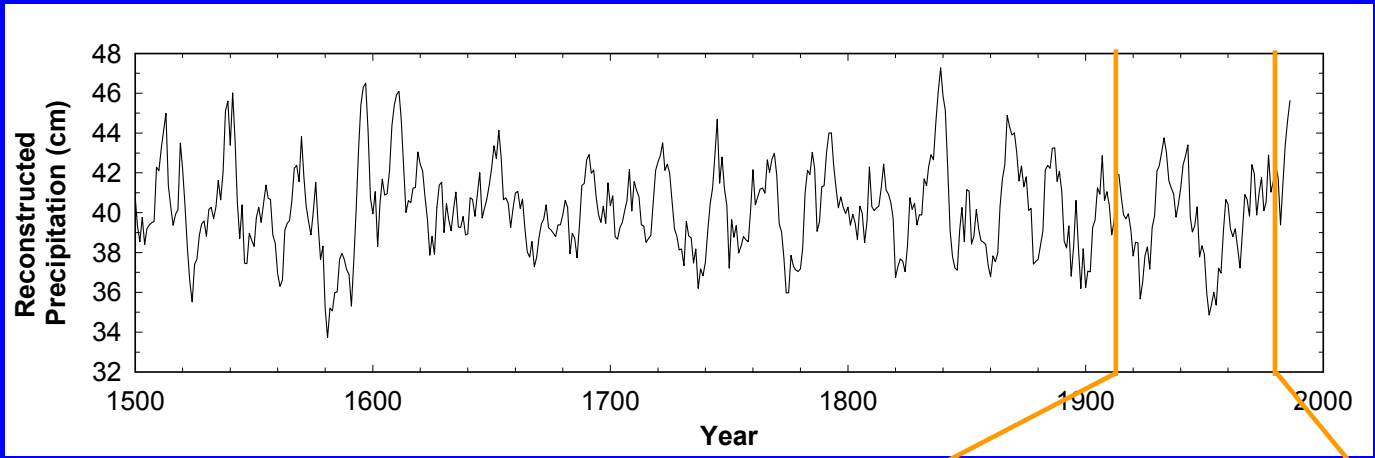


Laser Spark on Soil





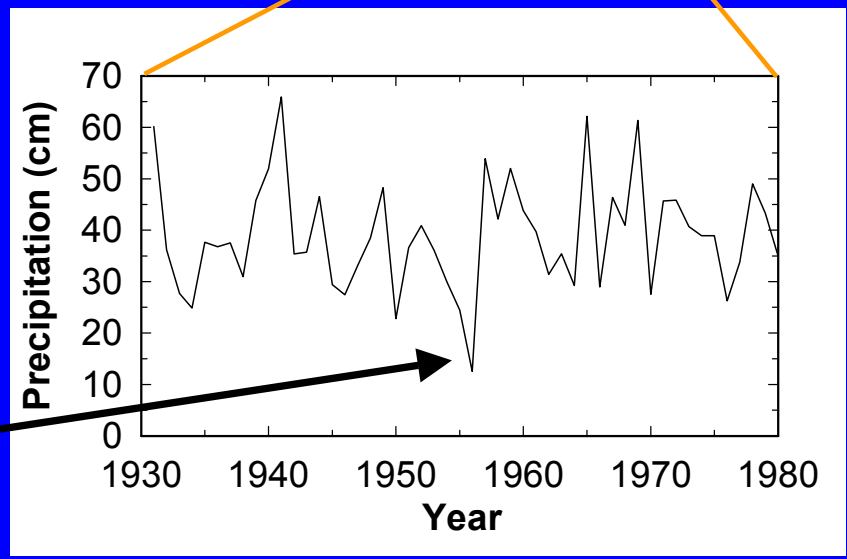
Drought



"killing virtually every pine, large and small, for miles around"

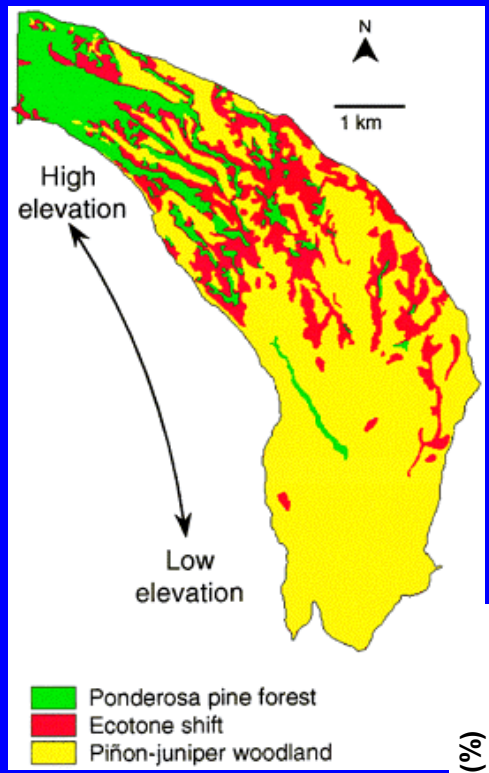
Tony Hillerman
June 23 1957, *Santa Fe New Mexican*

1950s Drought

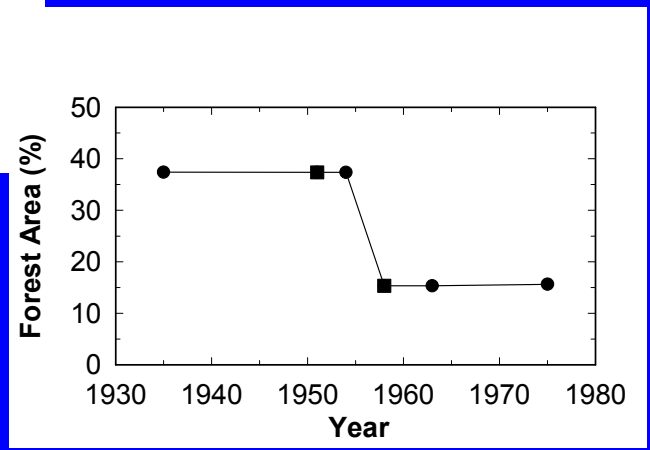


Allen & Breshears 1998 – *Proc. Natl. Acad. Sci USA*

Drought-Induced Tree Mortality



- *Rapid ecotone shift*
- *Forest fragmentation*
- *Regionally extensive*



Allen & Breshears 1998 – *Proc. Natl. Acad. Sci USA*

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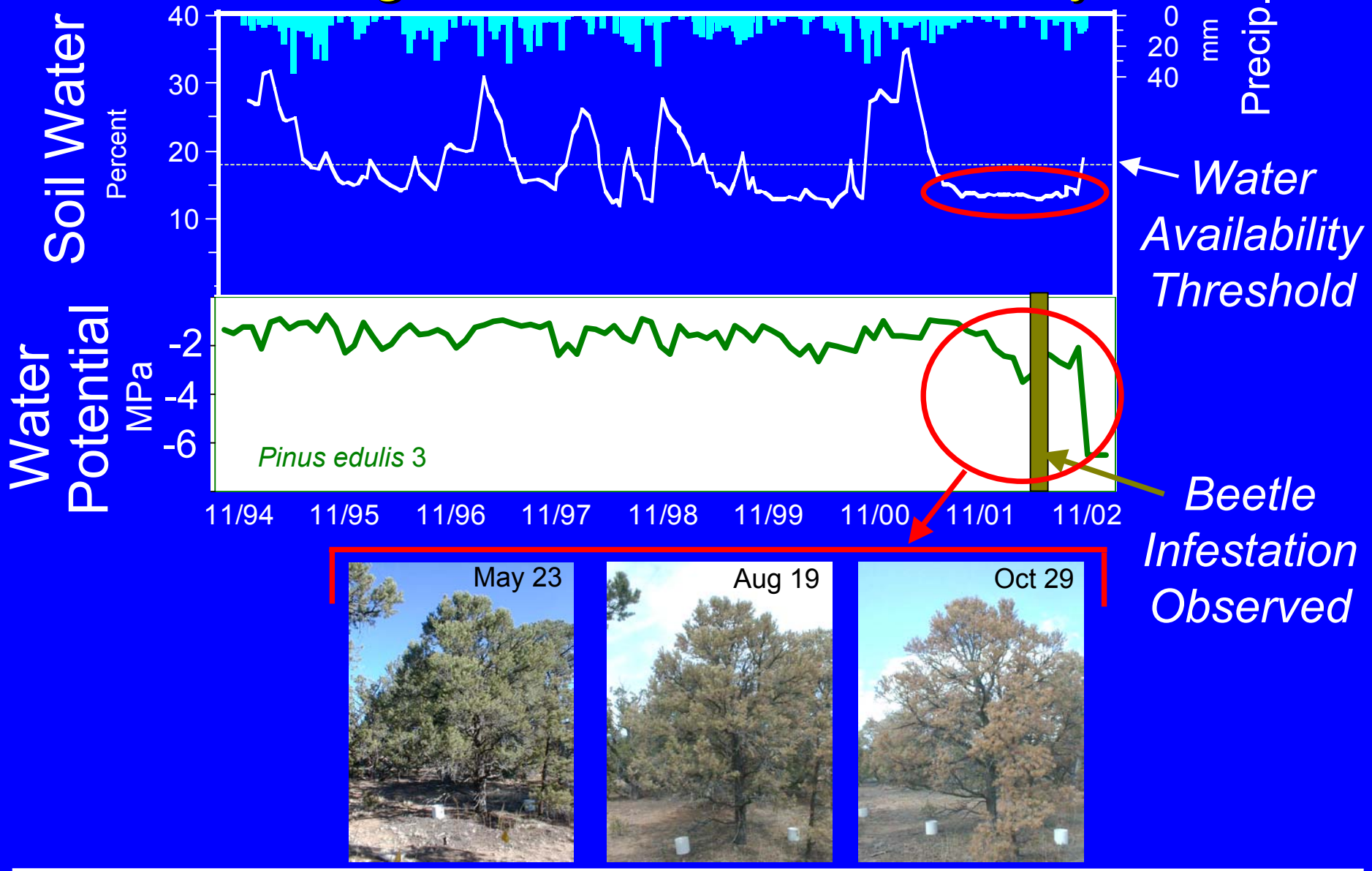
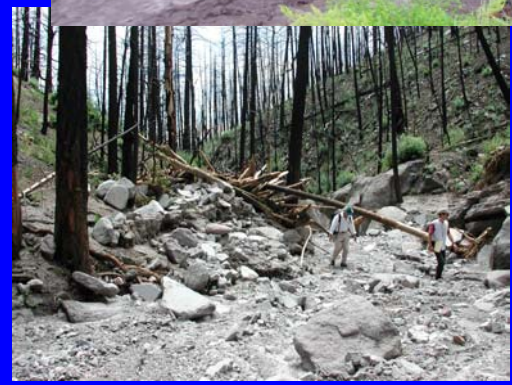


Breshears, Myers & Barnes – *In prep.*

Drought-Induced Increases in Erosion

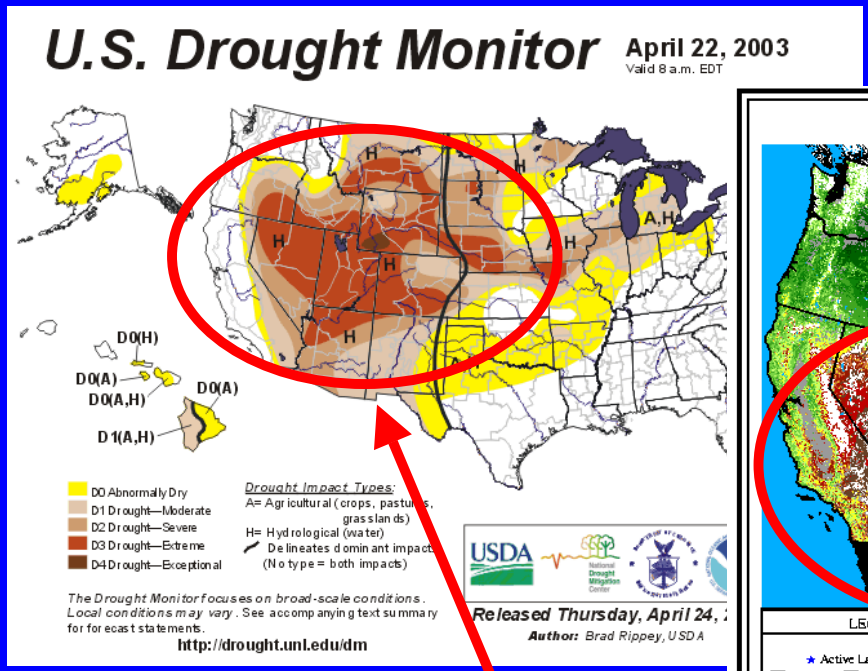
Allen & Breshears 1998 • Allen, Wilcox & Breshears – *In prep.*

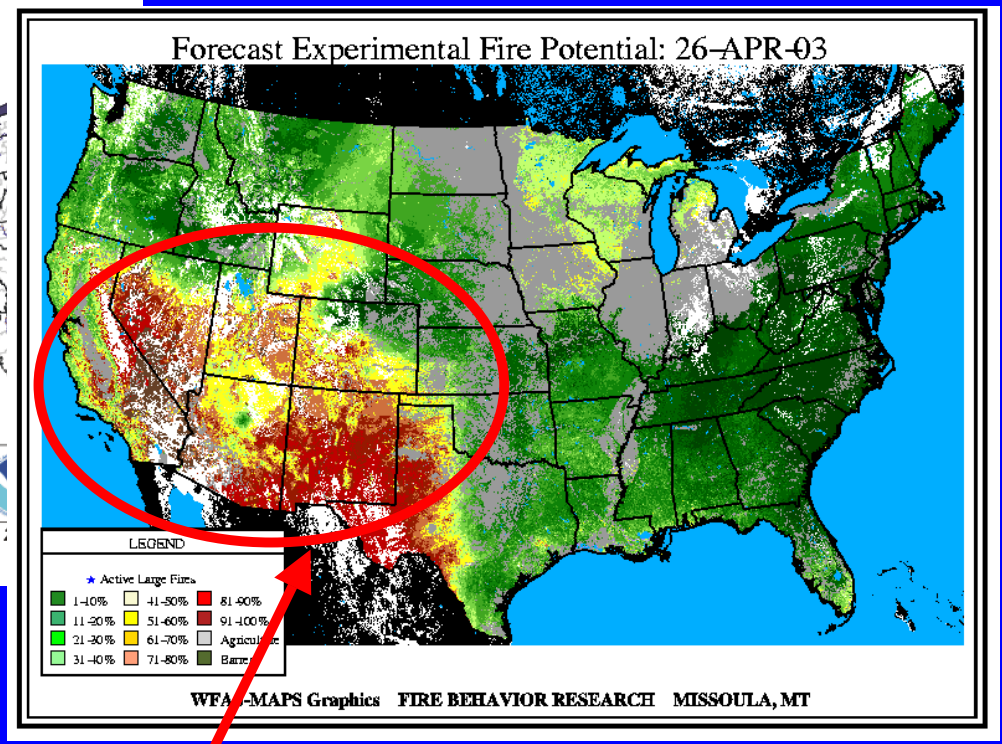
Post-fire Hydrology



Cerro Grande Fire
May 2000

Johansen, Hakonson, Whicker & Breshears – *In press: J. Env. Qual.*

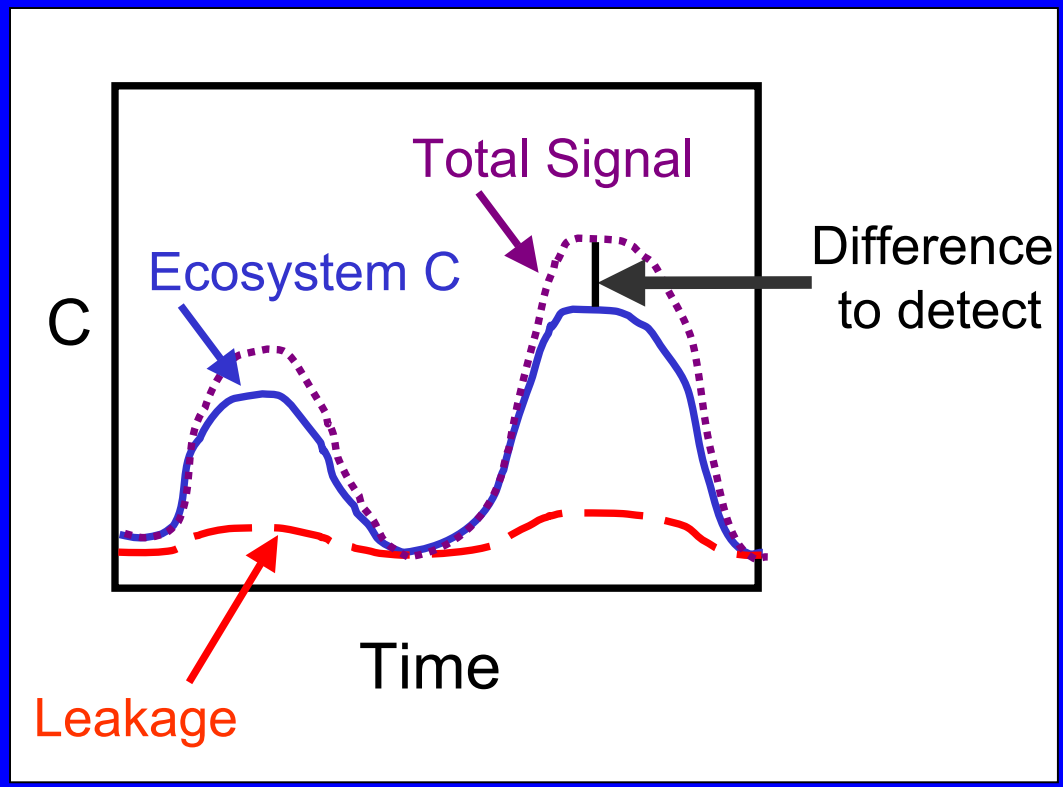




http://www.fs.fed.us/land/wfas/experment.htm

Drought and Fire Risks are Currently High

A Foundation for Measurement, Monitoring and Verification for Geological Sequestration



LIBS → *Soil Carbon Pattern*

Microbes → *Carbon Change*

Water → *Carbon Catalyst*

Ecosystem Dynamics → *Carbon Dynamics*

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